Mercury

CAS No. 7439-97-6

General Information

Mercury is a naturally occurring metal that has metallic, inorganic, and organic forms. Metallic mercury (quicksilver) is a shiny, silver-white liquid. Metallic elemental mercury is used to produce chlorine gas and caustic soda. It also can be used in detonating devices, cosmetics, pharmaceuticals, pesticides, blood pressure devices, electrical equipment (e.g., thermostats and switches), thermometers, dental fillings, and batteries. Spills of metallic mercury can volatilize into the air and be inhaled. Elemental mercury is poorly absorbed from the gastrointestinal tract. Vaporization of mercury from dental amalgams also contributes to exposure (Ritchie et al., 2002).

Inorganic mercury exists in two oxidative states (mercurous and mercuric) and combines with other elements, such as chlorine (mercuric chloride), sulfur, or oxygen, to form inorganic mercury compounds or salts. Inorganic mercury enters the air from the mining of ore deposits, the burning of coal, and the incineration of waste. It also enters the water or soil from natural deposits, disposal of wastes, and volcanic activity.

Mercury can combine with organic compounds (e.g., methyl mercury, phenyl mercury, merthiolate). In mercury-contaminated water or soil, microorganisms can organify mercury into methyl mercury, which concentrates in the food chain. Fish consumption is the primary source of methyl lmercury exposure in people.

The health effects of mercury are diverse and can depend on the form of the mercury encountered and the severity and length of exposure. With large acute exposures to elemental mercury vapor, the lungs may be injured. At levels below those that cause lung injury, low-dose or

Table 8. Mercury

Geometric mean and selected percentiles of blood concentrations (in µg/L) for males and females aged 1 to 5 years and females aged 16 to 49 years in the U.S. population, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
Age group								
1-5 years (males and females)	.343 (.299-.393)	< LOD	< LOD	.300 (.200-.300)	.500 (.500-.600)	1.40 (1.10-2.00)	2.30 (1.40-3.20)	705
Males	.317 (.270-.372)	< LOD	< LOD	.200 (.200-.300)	.500 (.500-.600)	1.10 (.800-1.50)	2.10 (1.10-3.50)	387
Females	.377 (.311-.457)	< LOD	< LOD	.200 (.200-.300)	.800 (.500-1.00)	1.60 (1.20-2.30)	2.70 (1.80-4.80)	318
16-49 years (females)	1.02 (.860-1.22)	.200 (<LOD-.200)	.400 (.400-.600)	.900 (.800-1.20)	2.00 (1.60-2.70)	4.90 (4.00-6.10)	7.10 (5.60-9.90)	1709
Race/ethnicity (females,16-49 years)								
Mexican Americans	.820 (.691-.974)	.200 (<LOD-.200)	.400 (.300-.500)	.900 (.700-1.00)	1.40 (1.20-1.90)	2.60 (2.10-3.40)	4.00 (2.70-5.50)	579
Non-Hispanic blacks	1.35 (1.11-1.64)	.300 (.200-.500)	.600 (.500-.900)	1.30 (1.10-1.60)	2.60 (1.90-3.30)	4.80 (3.30-6.60)	5.90 (4.40-10.9)	370
Non-Hispanic whites	.944 (.765-1.17)	< LOD	.400 (.300-.400)	.900 (.700-1.10)	1.90 (1.40-2.90)	5.00 (3.40-6.50)	6.90 (5.40-10.6)	588

< LOD means less than the limit of detection, which is 0.14 µg/L.

chronic inhalation may affect the nervous system. Symptoms include weakness; fatigue; loss of weight (with anorexia); gastrointestinal disturbances; salivation; tremors; and behavioral and personality changes, including depression and emotional instability.

Exposure to inorganic mercury usually occurs by ingestion. The most prominent effect is on the kidneys, where mercury accumulates, leading to tubular necrosis. In addition, there may be an irritant or corrosive effect on the gastrointestinal tract involving stomatitis, ulceration, diarrhea, vomiting, and bleeding. Psychomotor and neuromuscular effects also may occur.

Organic mercury is more toxic than inorganic mercury. The effects of organic mercury include changes in vision, sensory disturbances in the arms and legs, cognitive disturbances, dermatitis, and muscle wasting. The developing nervous system of the fetus and infants are considered to be susceptible to the effects of methyl mercury as measured by neurobehavioral testing in population studies (National Academy of Sciences, 2000). Information about external exposure (environmental levels) and health effects is available at the EPA IRIS Web site at http://www.epa.gov/iris and from ATSDR at http://www.atsdr.cdc.gov/toxprofiles.

Interpreting Blood and Urine Mercury Levels Reported in the Tables

Blood mercury levels were measured in a subsample of NHANES participants aged 1-5 years and in females aged 16-49 years. Urine mercury levels were measured in a subsample of females aged 16-49 years. Subsamples were randomly selected within the specified age ranges to be a representative sample of the U.S. population. The measurement of total blood mercury includes both inorganic and organic forms. In the general population, total blood mercury is due mostly to the dietary intake of organic forms, particularly methyl mercury. Urinary mercury mostly comprises inorganic mercury, since little organic mercury is excreted in the urine. These distinctions can assist in the interpretation of the meaning of elevated mercury blood levels in people. Finding a measurable amount of mercury in blood or urine does not mean that the level of mercury causes an adverse health effect.

Total blood mercury levels in this *Report* were well below occupational thresholds of concern. ACGIH recommends that the blood inorganic mercury of workers not exceed 15 µg/L and that urine values not exceed 35 µg/gram creatinine. Information about the biological exposure indices (BEI) is provided here for comparison,

Table 9. Mercury

Geometric mean and selected percentiles of urine concentrations (in µg/L) for females aged 16 to 49 years in the U.S. population, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
Age group (females)								
16-49 years	.720 (.642-.808)	< LOD	.310 (.260-.370)	.770 (.650-.880)	1.62 (1.46-1.84)	3.15 (2.68-3.58)	5.00 (3.86-5.55)	1748
Race/ethnicity (females,16-49 years)								
Mexican Americans	.724 (.607-.864)	< LOD	.280 (.240-.350)	.650 (.520-.890)	1.69 (1.33-2.35)	3.68 (3.10-4.45)	5.62 (4.68-7.51)	595
Non-Hispanic blacks	1.07 (.888-1.29)	< LOD	.450 (.360-.650)	1.03 (.870-1.34)	2.30 (1.85-2.89)	4.81 (3.41-6.08)	6.98 (5.13-9.64)	381
Non-Hispanic whites	.657 (.576-.748)	< LOD	.280 (.210-.340)	.710 (.560-.810)	1.50 (1.31-1.77)	2.84 (2.35-3.32)	4.05 (3.26-5.24)	594

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not to imply that the BEI is a safety level for general population exposure. The measurement of urinary protein excretion for assessment of early kidney tubular damage is also recommended. Roels et al. (1999) evaluated the utility of urinary mercury concentrations in assessing renal injury. They concluded that, to prevent cytotoxic and functional renal effects, urinary mercury levels should not exceed 50 µg/gram creatinine.

Blood mercury levels in this NHANES 1999-2000 subsample are consistent with levels found in other population studies. In Germany, the geometric mean for blood mercury was 0.58 µg/L in all 4,645 participants and was 0.33 µg/L for children 6-14 years old (Becker et al., 1998). During the years 1996 through 1998, Benes et al. (2000) studied 1,216 blood donors (896 males and 320 females; average age 33 years) and 758 children (average age 9.9 years). They found concentrations of mercury in blood for adults (medians) of 0.78 µg/L and in the juvenile population of 0.46 µg/L. Total blood mercury is known to increase with greater fish consumption (Grandjean et al., 1995; Mahaffey and Mergler 1998; Sanzo et al., 2001; Dewailly et al., 2001) and with the number of teeth filled with mercury-containing amalgams (Becker et al., 1998). The levels reported in this NHANES 1999-2000 subsample for maternal-aged females were below levels associated with in utero effects on the fetus, or with effects in children and adults (National Academy of Sciences, 2000).

Geometric mean blood levels of the demographic groups were compared after adjustment for the covariates of race/ethnicity, age, gender, log serum cotinine and urinary creatinine. Females aged 16-49 years had blood mercury levels that were more than double those of children aged 1-5 years. Among children 1-5 years old, girls had higher values than boys. In addition, non-Hispanic whites had lower blood mercury levels than either non-Hispanic blacks or Mexican Americans. Among maternal-aged women (16-49 years old), blood mercury levels in non-Hispanic blacks were higher than levels in non-Hispanic whites and Mexican Americans.

In this *Report*, no differences existed between racial/ethnic groups for urinary mercury levels. Use of certain mercury-containing cosmetic creams can increase urine mercury levels slightly (McRill et al., 2000).

These data provide physicians with a reference range so that they can determine whether people have been exposed to higher levels of mercury than those found in the general population. These data will also help scientists plan and conduct research about mercury exposure and health effects.

Table 10. Mercury (creatinine adjusted)

Geometric mean and selected percentiles of urine concentrations (in µg/gram of creatinine) for females aged 16 to 49 years in the U.S. population, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
Age group (females)								
16-49 years	.711 (.638-.792)	< LOD	.354 (.294-.422)	.723 (.640-.832)	1.41 (1.28-1.59)	2.48 (2.21-2.79)	3.27 (2.94-3.70)	1748
Race/ethnicity (females,16-49 years)								
Mexican Americans	.685 (.555-.846)	< LOD	.312 (.244-.400)	.639 (.487-.836)	1.45 (1.12-1.88)	2.89 (2.01-3.70)	4.51 (3.20-5.48)	595
Non-Hispanic blacks	.666 (.558-.796)	< LOD	.335 (.266-.414)	.615 (.503-.837)	1.22 (1.01-1.63)	2.56 (1.90-3.65)	3.99 (2.90-4.70)	381
Non-Hispanic whites	.706 (.621-.803)	< LOD	.368 (.289-.455)	.721 (.632-.846)	1.41 (1.26-1.64)	2.46 (2.16-2.78)	3.05 (2.56-3.76)	594

< LOD means less than the limit of detection (see previous table).